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# DEFENSE TRANSPORTATION

## Air Mobility Command Needs to Collect and Analyze Better Data to Assess Aircraft Utilization



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Highlights of [GAO-05-819](#), a report to the Secretary of Defense

## Why GAO Did This Study

Airlift is a flexible, but expensive, transportation method. From September 2001 to April 2005, the Department of Defense (DOD) has spent about \$9.5 billion using airlift to transport equipment, supplies, and troops for Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF). As of December 2004, airlift accounted for about 13 percent of all cargo and passengers transported for these operations. DOD has stated that high demand for available airlift assets requires the department to use airlift assets as efficiently as possible. However, DOD's primary objective emphasizes delivering "the right items to the right place at the right time" over using aircraft capacity as efficiently as possible.

Under the Comptroller General's authority, GAO sought to determine whether DOD used capacity on strategic military aircraft transporting cargo and passengers between the United States and overseas theaters for OEF and OIF as efficiently as possible.

## What GAO Recommends

GAO is making recommendations to improve DOD's collection and analysis of information on operational factors that impact payloads transported on strategic airlift missions. DOD concurred with our recommendations. However, based on DOD's comments, GAO has modified one recommendation.

[www.gao.gov/cgi-bin/getrpt?GAO-05-819](http://www.gao.gov/cgi-bin/getrpt?GAO-05-819).

To view the full product, including the scope and methodology, click on the link above. For more information, contact William Solis at (202) 512-5140 or [solisw@gao.gov](mailto:solisw@gao.gov).

# DEFENSE TRANSPORTATION

## Air Mobility Command Needs to Collect and Analyze Better Data to Assess Aircraft Utilization

### What GAO Found

Because the Air Mobility Command (AMC), which is the Air Force agency responsible for managing airlift, does not systematically collect and analyze operational factors that impact payloads on individual missions, DOD does not know how often it met its secondary goal to use aircraft capacity as efficiently as possible. AMC collects data about short tons transported and information about operational factors, such as weather and runway length, when planning and executing airlift missions. AMC does not capture data about these variables in a manner that allows officials to determine historically whether aircraft capacity was used efficiently. Historical mission planning files and the Global Air Transportation Execution System that is used to track mission data could provide some information about operational factors that affect mission payloads, but limitations associated with these data sources do not allow officials to determine whether DOD used aircraft capacity as efficiently as possible. In the absence of data about operational factors that impact payloads on specific missions, GAO calculated the average payloads for each type of strategic aircraft and compared these to historical average payloads, known as payload planning factors. GAO found that over 97 percent of C-5 missions and more than 81 percent of C-17 missions carried payloads below DOD's payload planning factors, as shown in the table below. However, because data on operational factors that impact payloads were not available, GAO was not able to determine whether these payloads indicate efficient use of aircraft capacity. Without adequate information about operational variables and how these impact mission payloads, AMC officials do not know the extent to which opportunities exist to use aircraft more efficiently and whether operational tempo, cost, and wear and tear on aircraft could be reduced. In addition, DOD officials do not have the benefit of such analysis to determine future airlift requirements for planning purposes.

**Number and Percentage of Missions Below, Meeting, or Exceeding AMC's Payload Planning Factors**

Type of aircraft	Number of missions	Payload planning factor (in short tons)	Number of missions below the payload planning factor	Percentage of missions below the payload planning factor	Number of missions meeting or exceeding the payload planning factor	Percentage of missions meeting or exceeding the payload planning factor
C-5	4,425	71.5	4,305	97.3	120	2.71
C-17	8,909	45.0	7,263	81.5	1,646	18.5
C-130	551	12.0	539	97.8	12	2.2
C-141	511	19.0	378	74.0	133	26
KC-10	186	32.6	152	81.7	34	18.3
KC-135	110	13.0	88	80.0	22	20
<b>Total</b>	<b>14,692</b>		<b>12,725</b>		<b>1,967</b>	

Source: GAO analysis of DOD data.

Notes: This analysis does not consider operational factors used for mission planning because data were not available. Although the C-130, KC-10, and KC-135 are not considered strategic airlift aircraft, GAO has included them in its analysis in those instances when AMC used these aircraft in strategic airlift roles. Because C-5 aircraft have separate compartments for passengers and cargo, we use a 71.5 payload planning factor (the sum of the cargo and passenger payloads).

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**Abbreviations**

AMC	Air Mobility Command
DOD	Department of Defense
GATES	Global Air Transportation Execution System
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
TRANSCOM	United States Transformation Command

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United States Government Accountability Office  
Washington, D.C. 20548

September 29, 2005

The Honorable Donald H. Rumsfeld  
Secretary of Defense

Dear Mr. Secretary:

When deploying forces overseas for the United States, the Department of Defense (DOD) uses a variety of means to transport equipment, supplies, and troops to a theater of operations, including rail, trucks, ships, and aircraft. From September 30, 2001, through April 30, 2005, DOD spent more than \$19 billion to transport equipment, supplies, and troops in support of the Global War on Terrorism, including Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF).<sup>1</sup> Of this, DOD has spent about \$9.5 billion to transport equipment, supplies, and troops for OEF and OIF via airlift, which is a fast and flexible, but expensive, transportation method relative to sealift. At the end of December 2004, airlift accounted for about 13 percent (464,239 short tons) of the more than 3.4 million short tons transported via airlift and sealift for these operations.<sup>2</sup> According to U.S. Air Force doctrine, high demand for limited airlift assets requires the department to use airlift as efficiently as possible while still meeting combatant commanders' delivery time frames. Because DOD emphasizes delivering the "right items to the right place at the right time" for the warfighter, this doctrine states that meeting mission needs is the Air Mobility Command's (AMC) primary objective, while the efficient use of aircraft capacity is a secondary goal. Nevertheless, United States Transportation Command (TRANSCOM) and AMC officials are looking for ways to decrease costs and use aircraft capacity as efficiently as possible while continuing to meet mission needs. These officials acknowledge that they need information that helps decision makers understand whether aircraft capacity was used efficiently while meeting mission needs, especially when the pace of operations is high, and to plan for future airlift transportation needs.

We conducted this review under the authority of the Comptroller General. We sought to determine whether DOD used strategic military aircraft efficiently during OEF and OIF. Specifically, our objective was to assess

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<sup>1</sup>OEF began in October 2001 in Afghanistan and OIF began in March 2003 in Iraq.

<sup>2</sup>A short ton is equivalent to 2,000 pounds.

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the extent to which DOD used all available space and weight on these aircraft when transporting equipment and supplies—hereafter referred to as “cargo”—and passengers for OEF and OIF to the extent possible.

In performing our work, we reviewed applicable DOD guidance, interviewed knowledgeable DOD officials, and analyzed AMC aircraft mission data. For purposes of this report, we focused our review of strategic airlift missions on contingency and special assignment airlift missions in support of OEF and OIF.<sup>3</sup> We excluded channel missions—scheduled flights over established worldwide routes on government-owned or chartered aircraft under the operational control of AMC that are used for cargo and troop movements—because these occur on a regular schedule, and it is possible that payloads would regularly be light. To obtain a better understanding of operational factors, such as weather, fuel considerations, and aircraft and airfield characteristics, that can impact payloads on individual missions, we reviewed a limited number of historical mission planning files for OEF and OIF and a Global Air Transportation Execution System (GATES) data field that could provide some information about operational factors on individual missions. However, limitations associated with these data sources prevent using these for analysis to determine whether DOD used aircraft capacity as efficiently as possible. In the absence of reliable data about operational factors, we obtained and analyzed strategic military airlift mission data for missions occurring from October 1, 2001, to September 30, 2004, for the two operations to get an indication of how well AMC utilized aircraft capacity. To determine whether DOD used capacity on these aircraft as efficiently as possible, we analyzed whether payloads transported for OEF and OIF met historical average payloads, known as payload planning factors. We compared average payloads transported by each aircraft type to the payload planning factors for each aircraft type. We also assessed the reliability of these data by reviewing existing documentation related to the data sources, electronically testing the data to identify obvious problems with completeness or accuracy, and interviewing knowledgeable agency officials about the data. We determined the data were sufficiently reliable for calculating average payloads transported on each type of aircraft. However, data were not sufficiently available to determine how operational

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<sup>3</sup>Contingency missions involve deployment, sustainment, and redeployment by airlift. Special assignment airlift missions are aircraft operated to satisfy a requirement needing special pickup or delivery at locations other than those with regularly scheduled service or to satisfy a requirement needing special consideration because of the number of passengers, weight or size of the cargo, urgency, or sensitivity of movement.

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factors impacted payloads transported on individual missions. Without information about operational factors that impacted payloads on these airlift missions, we are unable to determine whether DOD used aircraft capacity as efficiently as possible. We discussed our methodology with AMC officials who agreed that such an analysis was appropriate. We conducted our review from September 2004 through July 2005 in accordance with generally accepted government auditing standards. A detailed description of our scope and methodology is presented in appendix I.

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## Results in Brief

Because the AMC does not systematically collect and analyze operational factors that impact payloads on individual missions, DOD does not know how often it met its secondary goal to use aircraft capacity as efficiently as possible. According to U.S. Air Force doctrine, high demand for limited airlift assets requires the department to use airlift as efficiently as possible while still meeting combatant commanders' delivery time frames. Although the AMC collects data about short tons transported and information about operational factors, such as weather and runway length, as it plans and executes airlift missions, the command does not capture data about these factors in a manner that allows officials to determine historically whether DOD used aircraft capacity as efficiently as possible. Historical mission planning files and the Global Air Transportation Execution System, a database that is used to track mission data, could provide some information about operational factors that impact mission payloads for individual missions. However, limitations associated with these data sources—such as the completeness and format of mission files and unknown accuracy of a Global Air Transportation Execution System data field—prevent using these for analysis of aircraft capacity used. Without information about operational factors that impacted payloads on these airlift missions, we are unable to determine whether DOD used aircraft capacity as efficiently as possible. In the absence of data about operational factors that impact payloads on specific missions, we calculated the average payloads for each type of aircraft and compared these to payload planning factors—the historical average payloads transported on each type of aircraft. Our analysis of 14,692 strategic airlift missions flown in support of OIF and OEF showed that over 97 percent of C-5 missions and more than 81 percent of C-17 missions carried payloads below the relevant payload planning factors for these types of aircraft. Also, nearly 19 percent of the missions did not meet the minimum requirements of 15 short tons or 100 passengers to qualify for use of strategic airlift. However, AMC is required to provide airlift whenever cargo and passengers are approved for



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movement, even if minimum requirements for using strategic airlift are not met or the requirement will not use an aircraft's available capacity as efficiently as possible if this is the only way to accomplish the mission. Given the absence of information about operational factors that could explain why heavier payloads were not transported on specific missions, command officials do not know the extent to which opportunities exist to use aircraft capacity more efficiently. Potentially inefficient use of aircraft could cause higher operational tempo and may increase costs as well as wear and tear on aircraft. In addition, this lack of information could cause DOD to understate or overstate future lift requirements for planning purposes, and the right mix and number of aircraft may not be available for future contingencies.

We are making recommendations to improve the department's collection and analysis of information on operational factors that impact payloads transported on aircraft used for strategic airlift. DOD provided written comments on a draft of this report and concurred with each of our recommendations. Based on DOD's written comments, we modified one recommendation. DOD also provided technical comments on this report, and we made changes where appropriate. We have reprinted DOD's comments in appendix IV.

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## Background

TRANSCOM, located at Scott Air Force Base, Illinois, is a unified combatant command that provides air, land, and sea transportation for DOD, both in peacetime and wartime.<sup>4</sup> AMC, one of TRANSCOM's three component commands, provides strategic airlift, among other services—such as the Civil Reserve Air Fleet through which contracted commercial aircraft support DOD airlift requirements in emergencies when the need for airlift exceeds the capability of military aircraft—for deploying, sustaining, and redeploying U.S. forces worldwide.<sup>5</sup> Strategic airlift moves cargo and passengers between the continental United States and overseas theaters or between overseas theaters. AMC operates military aircraft that constitute

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<sup>4</sup>An unified combatant command is composed of forces from two or more services and has a broad and continuing mission.

<sup>5</sup>TRANSCOM's other component commands are the Surface Deployment and Distribution Command that is responsible for providing global surface distribution services, and the Military Sealift Command that provides ocean transportation of equipment, fuel, supplies and ammunition to sustain U.S. forces worldwide.

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the U.S. strategic airlift fleet, including the C-5, C-17, and C-141 aircraft (app. II describes each aircraft).<sup>6</sup> In addition, AMC can use aerial refueling aircraft, such as the KC-10 and KC-135, for transporting cargo. Although the C-130 is primarily used for intratheater airlift missions, AMC sometimes uses it in a strategic airlift role to transport cargo from the United States to Iraq and Afghanistan, especially if the aircraft is being moved into the theater and assigned to the United States Central Command. AMC's Tanker Airlift Control Center plans, schedules, and tracks tanker and airlift worldwide. The Fusion Cell, a division within AMC's Tanker Airlift Control Center, was created following the terrorist attacks of September 11, 2001, to provide senior decision makers with information about the movement of air mobility assets, especially for those missions associated with contingency operations. The Fusion Cell is charged with collecting and analyzing cargo and passenger data from completed missions using TRANSCOM- and AMC-owned and controlled databases, such as the Global Transportation Network, GATES, and the Global Decision Support System, and ensuring data quality.<sup>7</sup>

TRANSCOM uses the combatant commander's delivery date at the final destination as well as information about the number and type of troops and cargo—the requirement—needed to accomplish a specific mission to determine the appropriate type of transportation needed to meet that date, develop feasible transportation schedules for deploying forces, assign ports of embarkation, and determine the best mode of transportation. AMC uses 15 short tons or 100 passengers as the minimum requirement for strategic airlift and may combine cargo loads to meet this requirement. However, AMC is required to provide airlift whenever cargo and passengers are approved for movement even if minimum requirements for using strategic airlift are not met or the requirement will not use an aircraft's available capacity as efficiently as possible if this is the only way to accomplish the mission. If airlift is required, TRANSCOM tasks AMC with assigning and scheduling airlift. TRANSCOM reserves the use of airlift for

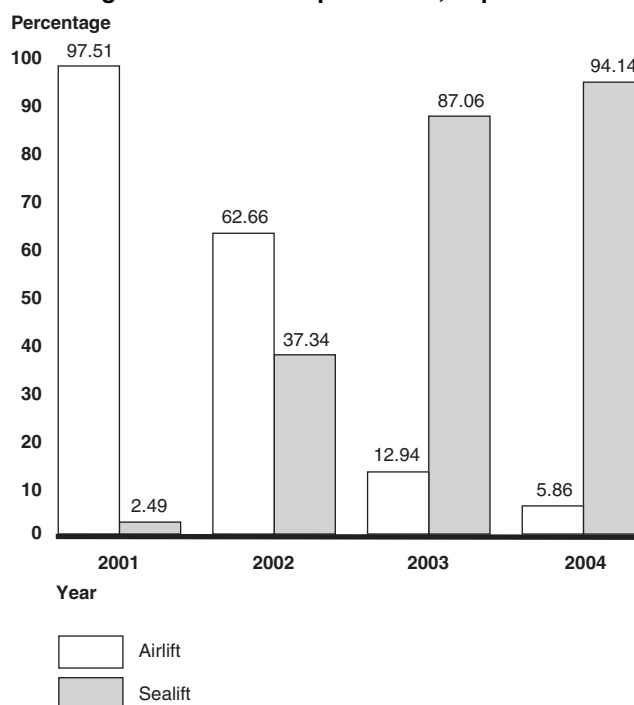
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<sup>6</sup>The Air Force retired its C-141s from the active duty inventory in September 2004. DOD plans to retire C-141s used by the Reserves and Air National Guard before 2006.

<sup>7</sup>TRANSCOM's Global Transportation Network collects and integrates information from a number of transportation systems to support transportation planning and decision-making. GATES provides AMC with automated capability to process and track cargo and passenger airlift data and facilitates payment for services. AMC's Global Decision Support System provides aircraft schedules, arrival and departure, and aircraft status data to support in-transit visibility of aircraft and aircrews.

(1) short notice and emergency requirements, (2) intelligence-related or sensitive cargo, and (3) when operational security considerations preclude the use of sealift. AMC assigns aircraft to move cargo and passengers based on (1) mission urgency and sensitivity, (2) cargo and passenger characteristics, and (3) other special factors. Currently, DOD transports the majority of cargo by sealift, as shown in figure 1.

**Figure 1: Percentage of Cargo Transported by Sealift and Airlift for Operations Enduring Freedom and Iraqi Freedom, September 2001 to December 2004**



Source: GAO analysis of DOD data.

AMC officials use the average historical payload transported on each type of aircraft (see table 1), known as payload planning factors, to develop broad estimates of the types and number of aircraft initially needed to meet mission requirements. The payload planning factors are generally less than the maximum payload capacity, including the weight of unit personnel, equipment, and material that an aircraft can carry, known as the allowable cabin load.

**Table 1: Payload Planning Factors and Allowable Cabin Loads for Strategic Aircraft**

In short tons

Aircraft type	Payload planning factor		Allowable cabin load
	Cargo	Passenger	
C-5	61.3	10.2	89.0
C-17	45.0	18.0	65.0
C-130	12.0	16.0	17.0
C-141	19.0	24.0	30.0
KC-10	32.6	13.6	60.0
KC-135	13.0	9.2	18.0

Source: United States Air Force.

Notes: The payload planning factor assumes loads contain only cargo or only passengers, not a mixture. For all aircraft types except the C-5, mixed loads usually would have payload planning factors in between the cargo and passenger payloads listed above. Because C-5s have separate compartments for passengers and cargo, the mixed payload planning factor would be the sum of the cargo and passenger payloads (71.5 short tons). Although the C-130, KC-10, and KC-135 are not considered strategic airlift aircraft, we have included them in our analysis in those instances when AMC used these aircraft in strategic airlift roles.

## The Extent to Which AMC Used Capacity as Efficiently as Possible on Strategic Military Aircraft Cannot Be Readily Ascertained

Because AMC does not systematically collect and analyze operational factors that impact payloads on individual missions, DOD does not know how often it met its secondary goal to use aircraft capacity as efficiently as possible. Historical mission planning files have limitations that prevent DOD officials from using the files to determine whether AMC used aircraft efficiently. In addition, data on operational factors captured in the GATES database are not useful because codes that could provide AMC officials with information about why aircraft flew with the payloads they did are neither well-defined nor comprehensive, and the accuracy and reliability of the data cannot be determined. In the absence of data about operational factors that impact payloads on individual missions, we calculated the average payloads for each type of strategic aircraft and compared these to the payload planning factors. Our analysis of AMC data showed that more than 86 percent of these missions flew with payloads that were lighter than established payload planning factors, and some of these did not meet the minimum requirement of 15 short tons or 100 passengers needed to qualify for use of strategic airlift. However, because AMC lacks data to determine how operational factors impact payloads, we are not able to determine whether these payloads indicate efficient use of an aircraft's capacity.

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## Historical Mission Planning Files Have Limitations That Prevent Their Use to Determine Whether AMC Used Aircraft Capacity as Efficiently as Possible

Historical mission planning files identify mission data and operational factors that may impact aircraft payloads, but we found limitations with using these files to determine whether AMC used an aircraft's capacity as efficiently as possible. We reviewed 25 historical mission planning files for OEF and OIF to gain an understanding of how operational factors could impact payloads. We found these files were not retained in a format that facilitates manipulation of data for analysis to determine whether an aircraft's capacity was used efficiently, and the files were not always complete or accurate. Although the historical mission planning files contain some information that could help identify operational factors that impacted aircraft payloads, the data are not easy to manipulate for analysis because the historical mission planning files are paper based. Currently, AMC stores the files in binders and boxes categorized by the operation, such as OEF, and the month and year of the flight. Officials told us that this organization system makes it difficult to access data for specific missions.

We also found that some of the files we reviewed were incomplete or inaccurate. For instance, 3 of the 25 mission files we reviewed were missing load plans that AMC officials use to identify appropriate aircraft with which to transport cargo and passengers. According to a command official, time constraints, among other factors, can impact whether load plans were sent to AMC. An official told us that units sometimes make changes to the load plans and do not inform AMC, which could cause aircraft to be underutilized if the allowable cabin load of the available and scheduled aircraft is too large for the size and weight of the requirement to be moved. AMC officials did not provide data on the frequency with which units make such changes. However, because of concerns about the accuracy of load plans, especially from units that do not deploy frequently, AMC officials told us that they always call units before scheduling aircraft to request load plans and confirm the accuracy of validated Time Phased Force and Deployment Data that identify the forces, sequence, and priority of unit deployments; the locations of ports of debarkation for a specific unit; and the number of pieces of cargo, cargo dimensions, and numbers and weights of passengers.

Despite these limitations, the mission planning files are the only combined source of mission information that includes load plans, diplomatic clearances, and air refueling requests and shows what was planned to be transported on an aircraft used for OEF and OIF. An AMC official told us that the historical mission planning files capture operational data that could be valuable for helping DOD understand the implications of moving

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to a lighter and faster force and projecting airlift assets needed to transport this force.

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**One AMC Database Is Also Not Useful for Assessing Whether Aircraft Capacity Was Used as Efficiently as Possible**

Operational data captured in one of AMC's databases, GATES,—the "system of record" database that provides AMC with automated capability to process and track cargo and passenger airlift data and facilitates payment for services—is also not useful for assessing whether AMC used an aircraft's capacity as efficiently as possible. When GATES was automated in 2000, command officials retained a data field called "Load Message Utilization" that consists of 13 codes that could provide AMC officials with information about why an aircraft flew with the payloads it did. AMC requires GATES users to manually enter a primary and, if relevant, a secondary code from the 13 codes presented in table 2 before transmitting mission data to AMC, although the command does not review or use this information for analysis.

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**Table 2: Load Message Utilization Data Field Codes and Definitions**

Code	
A	Pallet positions or seats not fully used due to substitute aircraft that provided more pallet positions or seats than the aircraft originally scheduled.
B	Excess seats. Scheduled or programmed passenger airlift capability in excess to station requirements.
C	Gained from previous station. All programmed seats used. Additional capability available to an en route station due to previous stations not using allocated seats.
D	Late passenger cancellations or no-show passengers.
E	Insufficient processed or palletized cargo on hand for downline stations, including cargo for other destinations that is authorized to be transshipped at downline stations (to be used if sufficient cargo is in the port, but not yet processed or movement ready).
F	Low port level. Insufficient cargo in port (both processed and unprocessed), for downline stations, including cargo for other destinations which is authorized to be transshipped at downline stations.
G	Additional crew members. Used when additional crew members preclude use of installed passenger seats or pallet positions.
H	Unsuitable cargo. Hazardous or other special handling cargo which precludes optimum utilization of cargo space or passenger seats.
J	Light pallets or cargo. All pallet positions used, but allowable cabin load not fully utilized due to light pallets or rolling stock or pallets with overhang which precludes full utilization of space.
K	Space block. Space not fully used due to passenger or cargo space blocks for downline stations.
V	Aircraft fully utilized, cargo mission only. Used when the percent utilized is 95 to 100 percent. Use the following formula: $\text{Payload/Allowable cabin load} \times 100 = \text{percent utilized}$ .
W	Aircraft fully utilized, passenger missions only. Used when 95 percent or more of available passenger seats were used for space required (duty) passengers.
Z	No other code applies. Provide short explanation in remarks.

Source: GATES Data Dictionary.

Although command officials could use some information captured in the “Load Message Utilization” data field to understand why aircraft flew with specific payloads, codes in this data field are neither well defined nor comprehensive, and the accuracy and reliability of the data are not known. There may be similar data fields in other transportation information systems such as the Global Transportation Network and Global Decision Support System that could be used to capture operational data. However, we are unaware of similar fields in these databases that could be modified for this use.

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According to AMC officials, some of the codes are not well defined and are inconsistently interpreted and applied by users. For example, the “V” code indicates that the aircraft is considered fully utilized only if the payload is 95 to 100 percent of the allowable cabin load. However, as we previously reported, an aircraft may be fully utilized with lighter payloads if the maximum volume of cargo that will fit into an aircraft is reached before the maximum cargo weight is reached.<sup>8</sup> AMC officials told us that most airlifted cargo loads reach maximum volume before reaching maximum weight. Additionally, an AMC official who reviewed the “Load Message Utilization” codes believes that users may have inappropriately applied the codes. We were not able to determine the extent to which users may have done this because we could not determine the reliability of data.

We also found that the codes are not as comprehensive as they could be. For example, there are no codes to indicate that an aircraft was fully utilized because the maximum volume of cargo that could fit into the aircraft was reached before the maximum cargo weight was reached. In addition, there are no codes that indicate if payloads were decreased to accommodate poor weather conditions; airfield characteristics, such as short runways; or aircraft characteristics, such as structural fatigue. Finally, no codes identify whether an aircraft’s capacity was underutilized because the only available aircraft was too large for the size and weight of the requirement to be moved within the time frame required. Although GATES users could enter such information using the “Z” code and associated remarks, this would not guarantee consistent remarks or allow for AMC officials to manipulate these data for analysis.

Finally, we were unable to assess the reliability or accuracy of “Load Message Utilization” data. Although the Chairman of the Joint Chiefs of Staff Manual recognizes that data quality is directly linked to data collection and entry at the port of embarkation and requires appropriate commander emphasis to ensure accuracy, aerial port supervisors are not required to review the “Load Message Utilization” code for accuracy prior to transmission to AMC. AMC officials told us that although they require this data field to be completed by users, AMC does not use this information and officials do not verify or validate the data entered in this data field. According to AMC officials, GATES users frequently use the “Z” code (no other code applies) as a placeholder.

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<sup>8</sup>GAO, *C-17 Globemaster: Support of Operation Joint Endeavor*, GAO-97-50 (Washington, D.C.: Feb. 14, 1997).



Analysis of AMC Data Showed That a Significant Number of Strategic Airlift Missions Flew with Payloads Lighter Than Established Planning Factors

Our analysis of 14,692 strategic airlift missions for OEF and OIF showed that more than 86 percent flew with payloads that were lighter than established payload planning factors; nearly 19 percent did not meet the minimum requirements of 15 short tons or 100 passengers needed to qualify for use of strategic airlift; and average payloads for strategic airlift missions were less than historical average payloads. For example, we found that over 97 percent of missions on C-5 aircraft, nearly 98 percent of missions on C-130 aircraft, and 80 percent of missions on KC-135 aircraft had payloads that were below the payload planning factors for these types of aircraft, as shown in table 3. In contrast, almost 19 percent of C-17 missions, about 18 percent of KC-10 missions, and 26 percent of C-141 missions met or exceeded the relevant payload planning factors.

Table 3: Number and Percentage of Missions Below, Meeting, or Exceeding Payload Planning Factors, by Plane Type, October 2001 to September 2004

Type of aircraft	Number of missions	Payload planning factor (in short tons)	Number of missions below the payload planning factor	Percentage of missions below the payload planning factor	Number of missions meeting or exceeding the payload planning factor	Percentage of missions meeting or exceeding the payload planning factor
C-5	4,425	71.5	4,305	97.3	120	2.71
C-17	8,909	45.0	7,263	81.5	1,646	18.5
C-130	551	12.0	539	97.8	12	2.2
C-141	511	19.0	378	74.0	133	26
KC-10	186	32.6	152	81.7	34	18.3
KC-135	110	13.0	88	80.0	22	20
Total	14,692		12,725		1,967	

Source: GAO analysis of DOD data.

Notes: This analysis does not consider operational factors used for mission planning because data were not available. Although the C-130, KC-10, and KC-135 are not considered strategic airlift aircraft, we have included them in our analysis in those instances when AMC used these aircraft in strategic airlift roles. Because C-5 aircraft have separate compartments for passengers and cargo, we use a 71.5 payload planning factor (the sum of the cargo and passenger payloads) rather than the 61.3 short tons published in Air Force Pamphlet 10-1403. For a C-5 aircraft to be fully utilized, DOD would need to fully utilize available space in both the cargo and passenger compartments.

However, because AMC lacks data to determine how operational factors impact payloads (see app. III for details on some of these factors), we are not able to determine whether these payloads indicate efficient use of an aircraft’s capacity.

Our analysis also showed that about 4 percent (524) of strategic airlift missions carried no cargo and nearly 19 percent (2,734) of all strategic airlift missions transporting cargo and passengers for OEF and OIF did not meet the minimum requirements for use of strategic airlift, resulting in light payloads and, potentially, underutilization of aircraft (see table 4). Missions that did not meet minimum requirements for strategic airlift carried an average of about 5 short tons of cargo and 26 passengers.

**Table 4: Missions Carrying No Cargo and Not Meeting the Minimum Requirements for Use of Strategic Airlift**

Type of aircraft	Number of missions	Operation Enduring Freedom		Operation Iraqi Freedom	
		Number of missions with no cargo	Number of missions not meeting minimum requirement for strategic airlift	Number of missions with no cargo	Number of missions not meeting minimum requirement for strategic airlift
C-5	4,425	49	123	21	131
C-17	8,909	185	1,175	36	468
C-130	551	80	48	112	237
C-141	511	4	175	6	181
KC-10	186	2	20	3	99
KC-135	110	21	46	5	31
<b>Total</b>	<b>14,692</b>	<b>341</b>	<b>1,587</b>	<b>183</b>	<b>1,147</b>

Source: GAO analysis of DOD data.

Note: Although the C-130, KC-10, and KC-135 are not considered strategic airlift aircraft, we have included them in our analysis in those instances when AMC used these aircraft in strategic airlift roles.

However, because AMC lacks data to determine how operational factors impact payloads, we are not able to determine whether these payloads indicate efficient use of an aircraft's capacity.

Although aerial port officials may know why individual flights flew empty or with light payloads, AMC does not collect these data, and available data collected by AMC were not sufficient to determine why this occurred. AMC officials told us that data show that some aircraft flew empty, possibly because the command tracks mission data for aircraft without cargo on board that were moved into the theater and assigned to the United States Central Command. According to these officials, the lack of technology at austere locations also prevents capturing mission data, including payloads transported. AMC officials further explained that although their databases also track classified missions, they do not capture payloads or other data for these missions.

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There may be legitimate reasons why AMC flew missions that did not meet minimum requirements for the use of strategic airlift. For instance, aircraft transporting light but bulky cargo could have light payloads. Charleston Air Force Base officials told us that they had transported rolls of bubble wrap to package Patriot missiles for return to the United States by airlift. For this mission, the payload was light, but the aircraft was fully utilized because the rolls used all available locations where cargo can be placed. AMC officials also told us that they attempt to use capacity as efficiently as possible by scheduling an aircraft that is sufficient for the size and weight of the requirement to be moved, scheduling en route stops to consolidate smaller loads, and negotiating delivery dates when possible. However, unlike commercial cargo carriers such as Federal Express, AMC officials cannot decline to deliver a customer's order if it does not fully utilize the aircraft. AMC is required to provide airlift whenever cargo and passengers are approved for movement even if minimum requirements for using strategic airlift are not met or the requirement will not fully utilize an aircraft's available capacity. A command official also told us that DOD guidance permits the use of strategic airlift even if the minimum requirements of 100 passengers or 15 short tons of cargo are not met if this is the only way to accomplish the mission. Therefore, AMC may fly aircraft with reduced payloads in order to meet combatant commanders' delivery time frames. While we believe this may cause aircraft to be underutilized, AMC officials emphasized that the command's primary objective is to deliver "the right items to the right place at the right time" and that optimizing capacity is a secondary goal. Furthermore, according to a command official, DOD established these minimum requirements as a way to identify large enough loads to justify sending a C-141 or C-17 aircraft to complete a mission.

However, without information about operational factors that impacted the payloads on these airlift missions, we are unable to determine whether DOD used an aircraft's capacity as efficiently as possible. In the absence of such data, we calculated the average payloads for each type of aircraft and compared these to relevant payload planning factors to get an indication as to how well AMC utilized aircraft. We found that aircraft payloads for OEF and OIF were, on average, less than historical average payloads. Table 5 shows the average payloads transported for both OEF and OIF by each type of strategic aircraft and how they compare to each aircraft's payload planning factor.

**Table 5: Payloads Transported by Type of Aircraft, October 2001 to September 2004**

In short tons

Type of aircraft	Average payload for Operation Enduring Freedom	Average payload for Operation Iraqi Freedom	Average payload for both operations	Payload planning factor
C-5	47.8	48.0	47.9	71.5 <sup>a</sup>
C-17	27.5	29.8	28.3	45.0
C-130	4.5	5.4	5.0	12.0
C-141	15.7	16.6	16.5	19.0
KC-10	12.9	17.9	17.3	32.6
KC-135	6.5	7.6	6.9	13.0

Source: GAO analysis of DOD data.

Note: Although the C-130, KC-10, and KC-135 are not considered strategic airlift aircraft, we have included them in our analysis in those instances when AMC used these aircraft in strategic airlift roles.

<sup>a</sup>The payload planning factor assumes loads contain only cargo or only passengers, not a mixture. For all aircraft types except the C-5, mixed loads usually would have payload planning factors in between the cargo and passenger payloads listed in table 1. Because C-5s have separate compartments for passengers and cargo, the mixed payload planning factor would be the sum of the cargo and passenger payloads (71.5 short tons).

Because AMC lacks data to determine how operational factors impact payloads, we are not able to determine whether these payloads indicate efficient use of an aircraft's capacity.

In general, in the absence of information about operational factors that could explain why heavier payloads were not transported, command officials do not know whether and where opportunities existed to use an aircraft's capacity more efficiently or if there is the opportunity to reduce operational tempo, costs, and wear and tear on aircraft. By not collecting information about and analyzing the factors that impact aircraft capacity utilized, DOD officials could also be understating lift requirements for planning purposes, and the right mix and number of aircraft may not be available for future contingencies.

## Conclusions

Because DOD emphasizes delivering the "right items to the right place at the right time" over the efficient use of an aircraft's capacity, AMC has a reason for underutilizing aircraft capacity on some missions. However, we believe that AMC officials need more data about operational factors, which can also impact aircraft capacity, and that these data need to be maintained in a manner allows officials to determine whether DOD used an aircraft's capacity as efficiently as possible. Furthermore, we believe it is important

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that reliable and complete data are collected to allow DOD and the Congress to make informed decisions about future airlift requirements. We have reported that a key factor contributing to the usefulness of data is the degree to which officials are confident that information is credible.<sup>9</sup> Useful practices for helping decision makers assess the quality and value of data include assessing the reliability and verifying and validating data to ensure that they adequately represent actual performance. Such data could help officials make informed decisions about the capacity of aircraft utilized when transporting cargo on strategic missions as well as planning for future strategic lift requirements. Because they do not collect information about and analyze the factors that impact payloads, DOD officials do not have adequate information about aircraft capacity and do not know whether capacity is utilized to the maximum extent possible. Potentially inefficient use of aircraft capacity could cause higher operational tempo and may increase cost as well as wear and tear on aircraft. In addition, this lack of information could cause DOD to understate or overstate future lift requirements for planning purposes, and the right mix and number of aircraft may not be available for future contingencies.

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## Recommendations for Executive Action

To help officials determine whether they used an aircraft's capacity as efficiently as possible and improve the reliability and completeness of data on operational factors that can impact payloads, we recommend that the Secretary of Defense direct the Secretary of the Air Force to direct the Commander, Air Mobility Command, to take the following two actions:

- Revise and clarify relevant data fields in GATES, and work with DOD entities that support other transportation information systems, such as the Global Transportation Network and service deployment systems, to capture comprehensive, well-defined data on operational factors that impact payloads for individual missions, and require supervisors to review these data fields for accuracy. These factors include—but are not limited to—number of pallet positions used, cargo dimensions, fueling decisions, and altitude constraints.
- Systematically collect and analyze information on operational factors that impact payloads transported on strategic airlift missions to identify

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<sup>9</sup>GAO, *Defense Management: Tools for Measuring and Managing Defense Agency Performance Could Be Strengthened*, [GAO-04-919](#) (Washington, D.C.: Sept. 13, 2004).

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ways that DOD may be able to use an aircraft's capacity as efficiently as possible.

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## Agency Comments and Our Evaluation

DOD's comments are reprinted in appendix IV. In commenting on a draft of this report, DOD concurred with both recommendations. It also provided technical comments, which we included in the report as appropriate.

DOD concurred with our recommendation to revise and clarify GATES data fields to capture a more comprehensive, well-defined list of operational factors that impact payloads for individual missions. In concurring with our recommendation, DOD made two additional comments. First, DOD noted that some contingency missions are often processed through service deployment systems and that other systems are also used to collect data regarding aircraft utilization. We agree with DOD that contingency missions are processed through systems other than GATES. However, as noted in our report, we used data on completed missions obtained from the Tanker Airlift Control Center's Fusion Cell database, which compiles and validates data obtained from GATES as well as the Global Transportation Network and the Global Decision Support System. AMC officials agreed with this methodology and these sources for our analysis. Second, DOD stated that data shortfalls are not only in GATES and that data such as altitude constraints, fueling decisions, and other operational decisions conducted outside the aerial ports do not belong in GATES. We agree with DOD that GATES is not a full-spectrum airfield and airlift planning and execution system, and that GATES may not be the only system that could capture the necessary information needed for a more comprehensive analysis of aircraft utilization. During the course of this review, we were not made aware of data fields in other information systems that captured information similar to the "Load Message Utilization" field in GATES. As a result, we focused our recommendation on GATES to identify how improvements could be made to transportation information systems to capture data on operational factors that could provide a more comprehensive picture of how well AMC and the combatant commanders are utilizing aircraft. In response to DOD's comments, we also reviewed user guides and data dictionaries for these other systems and identified a number of data fields that could provide additional operational data. However, in further discussions, DOD officials told us that data in these fields are not always easily accessible or complete and reliable. Therefore, to recognize that there may be other systems that could also be used to capture operational data, we have revised our recommendation for DOD to

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revise and clarify data fields in GATES and any other transportation information systems.

DOD concurred with our second recommendation to systematically collect and analyze information on operational factors that impact payloads transported on strategic airlift missions and stated that AMC's Tanker Airlift Control Center already collects and analyzes mission data from several transportation information systems, including allowable cabin load utilization by aircraft type. As noted in our scope and methodology, for our analysis of aircraft utilization we used data obtained from the Tanker Airlift Control Center's Fusion Cell database, which compiles data obtained from GATES as well as the Global Transportation Network and the Global Decision Support System. However, this database did not include the operational data we believe is needed by DOD to analyze and better understand how operational factors impact these payloads, to determine whether all available space and weight on these aircraft was used in light of such operational factors, and to plan for future airlift transportation needs.

DOD also stated that any audit of contingency aircraft utilization must include the Time Phased Force Deployment Data validation process. We acknowledge that this process plays an integral role in determining what needs to be moved and how it is moved. However, our objective was to determine how efficiently AMC utilized its airlift assets after that validation process is completed; therefore, the process is outside of the scope of our review. As we discuss in the background and appendix III, AMC is required to provide airlift whenever cargo and passengers are approved for movement even if minimum requirements for using strategic airlift are not met or the requirement will not use an aircraft's available capacity as efficiently as possible, if this is the only way to accomplish the mission. This means that if a combatant commander puts forward a requirement through the Time Phased Force Deployment Data validation process and it is designated by TRANSCOM for airlift, AMC will fly the mission, even if it does not meet the minimum requirements or allow the most efficient use of capacity.

As you know, 31 U.S.C. § 720 requires the head of a federal agency to submit a written statement on actions taken to address our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Reform not later than 60 days after the date of this report. A written statement must also be submitted to the House and Senate Committees on Appropriations with the agency's first

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request for appropriations made more than 60 days after the date of this report.

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We are sending copies of this report to interested congressional committees; the Secretaries of the Army, the Navy, and the Air Force; the Commandant of the Marine Corps; and the Director, Office of Management and Budget. We will make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>.

If you or your staff have any questions regarding this report, please contact me at (202) 512-5140 or [solisw@gao.gov](mailto:solisw@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix V.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'W. Solis', with a large, stylized loop at the end.

William Solis  
Director, Defense Capabilities and Management



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# Scope and Methodology

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To assess the extent to which the Department of Defense (DOD) used an aircraft's capacity as efficiently as possible while transporting cargo and passengers for Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF), we reviewed relevant DOD guidance and defense transportation regulations and interviewed knowledgeable officials from the following offices, commands, and services:

- 13<sup>th</sup> Corps Support Command, Fort Hood, Killeen, Texas.
- 3<sup>rd</sup> Army Corps, Directorate of Logistics, Fort Hood, Killeen, Texas.
- 437<sup>th</sup> Aerial Port Squadron, Charleston Air Force Base, South Carolina.
- 4<sup>th</sup> Infantry Division, Fort Hood, Killeen, Texas.
- 819<sup>th</sup> Rapid Engineer Deployable Heavy Operational Repair Squadron Engineer, Malmstrom Air Force Base, Montana.
- Air Mobility Command (AMC), Scott Air Force Base, Illinois.
- I Marine Expeditionary Force, Camp Pendleton, California.
- II Marine Expeditionary Force, Camp Lejeune, North Carolina.
- Joint Chiefs of Staff, Joint Staff Logistics Directorate, Arlington, Virginia.
- Office of the Secretary of Defense, Program Analysis and Evaluation, Arlington, Virginia.
- United States Central Command, MacDill Air Force Base, Tampa, Florida.
- United States Joint Forces Command, Norfolk, Virginia.
- United States Army Forces Command, Fort McPherson, Georgia.
- United States Army Installation Management Agency, Arlington, Virginia.
- United States Transportation Command, Scott Air Force Base, Illinois.

To gain an understanding of how operational realities can affect aircraft payloads, we reviewed a limited number of historical mission planning files. The files that we reviewed were sometimes missing load plans that would assist in explaining operational factors that may have impacted payloads. When load plans were present in the mission files, AMC officials were able to identify a number of factors that could plausibly impact mission payloads; however, they could not be certain that these factors did impact payloads when the mission was executed. We also reviewed information about the “Load Message Utilization” data field in the Global Air Transportation Execution System and discussed the reliability and accuracy of these data with AMC and aerial port officials. We determined that this data field was not sufficiently reliable for this purpose. We also met with officials concerning AMC’s Global Transportation Network and Global Decision Support System.

We limited our review of airlift missions to strategic contingency missions and special assignment airlift missions for the Army, Navy, Air Force, and Marine Corps as well as joint missions flown on AMC-owned and AMC-operated aircraft in support of OEF and OIF. The U.S. strategic airlift fleet includes the C-5, C-17, C-130, and C-141 aircraft. Because aerial refueling aircraft, such as the KC-10 and KC-135, are also capable of transporting cargo for strategic airlift missions, we also included these aircraft in our analyses. We initially obtained mission data for 37,622 airlift missions<sup>1</sup> occurring from October 1, 2001, to September 30, 2004 from AMC’s Fusion Cell.

Because we focused on strategic missions, we excluded intratheater missions from our analyses. In addition, we excluded channel missions—regularly scheduled flights on government-owned or chartered aircraft under the operational control of AMC that are used for cargo and troop movements—because these occur on a regular schedule, and it is possible that payloads would regularly be light. We also excluded missions on commercial aircraft because these are not owned by AMC. By applying our selection criteria identified earlier, we narrowed the number of missions that we reviewed to 14,692. To assess the reliability of these data, we (1) reviewed existing documentation related to the data sources,

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<sup>1</sup>When selecting missions to analyze, we used the mission leg with the greatest short tons on board, including passenger weight. The approximately 170,000 mission legs that AMC flew during this time frame resulted in 37,622 unique missions prior to application of our selection criteria. Based on discussions with Fusion Cell staff clarifying our analysis results, we eliminated 6 missions from our analysis that showed improbably high payloads.

(2) electronically tested the data to identify obvious problems with completeness or accuracy, and (3) interviewed knowledgeable agency officials about the data. We determined that the Fusion Cell's data were sufficiently reliable to summarize the actual cargo and passenger payloads. We then compared Fusion Cell average payload data for OEF and OIF strategic aircraft with payload planning factors and determined whether payloads for OEF and OIF met the payload planning factors. We also calculated the average total short tons transported on each type of aircraft, and determined the percentage of aircraft that carried short tons in excess as well as below the payload planning factors. Additionally, we determined the number of missions that did not meet the minimum strategic airlift requirements of 15 short tons or 100 passengers. DOD guidance permits the use of strategic airlift even if minimum payload and passenger requirements are not met if this is the only way to accomplish the mission. Furthermore, AMC is required to provide airlift whenever cargo and passengers are validated for movement even if the minimum requirement to use strategic airlift is not met. However, we were not able to determine the reasons why the minimum requirement was waived for nearly 19 percent of all missions we reviewed. We also identified a number of missions that carried no cargo or passengers; however, we were not able to identify all of the reasons why these aircraft flew empty.

We conducted our review from September 2004 through July 2005 in accordance with generally accepted government auditing standards.

# Air Mobility Command Aircraft Used for Strategic Airlift

The AMC is responsible for providing global airlift services and air refueling operations. To carry out its mission, the command has a strategic airlift fleet comprised of the C-5, C-17, and C-141. In addition, AMC can use aerial refueling aircraft, such as the KC-10 and KC-135, for transporting cargo. Although the C-130 is primarily used for intratheater airlift missions, AMC sometimes uses it in a strategic airlift role to transport cargo from the United States to Iraq and Afghanistan, especially if the aircraft is being moved into the theater and assigned to the United States Central Command. This appendix briefly describes these aircraft (figs. 2 through 7 are photographs of the various aircraft).

## C-5 Aircraft

**Figure 2: C-5 Aircraft**



Source: DOD.

The C-5 is one of the largest aircraft in the world. It can carry outsize and oversize cargo over intercontinental ranges and can take off or land in relatively short distances. A C-5 with a cargo load of 135 short tons can fly 2,150 nautical miles, off-load, and fly to a second base 500 nautical miles away from the original destination without aerial refueling. With aerial refueling, the aircraft's range is limited only by crew endurance. The C-5 can carry nearly all of the Army's combat equipment, including large heavy items such as the 74-ton mobile scissors bridge. Ground crews can load and off-load the C-5 simultaneously at the front and rear cargo openings. The landing gear system permits lowering of the parked aircraft so the cargo

floor is at truck bed height or to facilitate vehicle loading and unloading. The aircraft length is about 247 feet, its height is approximately 65 feet, and its wing span is about 223 feet.

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## C-17 Aircraft

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**Figure 3: C-17 Aircraft**



Source: DOD.

The C-17 aircraft is capable of transporting substantial payloads over long ranges without refueling. The C-17 is intended to deliver cargo and troops directly to forward airfields near the front lines or to main operating bases; fly into small, austere airfields; land on short runways; transport outsize cargo, such as tanks; and air-drop troops and equipment. The C-17 can take off and land on runways as short as 3,000 feet long and 90 feet wide. With a payload of 80 short tons and an initial cruise altitude of 28,000 feet, the C-17 has an unrefueled range of approximately 2,400 nautical miles. The aircraft length is 174 feet, its height is about 55 feet, and its wing span is almost 170 feet. The C-17 will be AMC's primary military airlift aircraft once the C-141s are retired from service.

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## C-141 Aircraft

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**Figure 4: C-141 Aircraft**



Source: DOD.

The C-141 was AMC's first jet aircraft designed to meet military standards as a troop and cargo carrier, and is used to airlift combat forces over long distances, deliver those forces and their equipment either by landing or airdrop, resupply forces, and transport the sick and wounded from a hostile area to medical facilities. The aircraft length is approximately 168 feet, its height is about 39 feet, and the wing span is 160 feet. The Air Force retired its C-141s from the active duty inventory in September 2004 and began transferring C-141s to the Air Reserve and Air National Guard forces in July 1986. DOD plans to retire C-141s used by the Air Reserves and Air National Guard before 2006.

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## C-130 Aircraft

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**Figure 5: C-130 Aircraft**



Source: DOD.

The C-130 is the primary transport aircraft for air-dropping troops and equipment into hostile areas. Other roles include airlift support, Antarctic ice resupply, and aeromedical missions. Using its aft loading ramp and door, the C-130 can accommodate oversized cargo, including utility helicopters and six-wheeled armored vehicles, as well as standard palletized cargo and military personnel. Additionally, the C-130 can be rapidly reconfigured for various types of cargo, such as palletized equipment, floor-loaded material, airdrop platforms, container delivery system bundles, vehicles and personnel, or aeromedical evacuation. In an aerial delivery role, it can airdrop loads up to 21 short tons or use its high-flotation landing gear to land and deliver cargo on rough, dirt strips. The C-130 has a length of about 97 feet, a height of approximately 38 feet, and a wing span of about 132 feet. Depending on the aircraft model, the C-130 can carry a maximum of 6 to 8 pallets, 92 to 128 combat troops, or a combination of any of these up to the cargo compartment capacity or maximum allowable weight.

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## KC-10 Aircraft

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**Figure 6: KC-10 Aircraft**



Source: DOD.

Although the KC-10's primary mission is aerial refueling, it can combine the tasks of a tanker and cargo aircraft by refueling fighters and simultaneously carrying the fighter support personnel and equipment on overseas deployments. The KC-10 can transport up to 75 people and nearly 85 short tons of cargo a distance of about 4,400 miles without refueling. The large cargo-loading door can accommodate most Air Forces fighter unit support equipment. Powered rollers and winches inside the cargo compartment permit moving heavy loads. The cargo compartment can accommodate loads ranging from 27 pallets to a mix of 17 pallets and 75 passengers. The aircraft's length is almost 182 feet. It has a height of approximately 58 feet and a wing span of about 165 feet.



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## KC-135 Aircraft

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**Figure 7: KC-135 Aircraft**



Source: DOD.

The KC-135's principal mission is air refueling. However, a cargo deck above the refueling system can transport a mixed load of passengers and cargo. The KC-135 can carry up to 41.5 short tons of cargo or 37 passengers. The aircraft length is about 136 feet, its height is approximately 42 feet, and it has a wing span of nearly 131 feet.

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# Operational Factors That Can Affect Aircraft Capacity Utilized

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The extent to which an aircraft's capacity is utilized on any mission depends on the interrelationship of a number of operational factors, including (1) operating constraints, such as the flight distance and aircraft availability; (2) environmental factors, such as airfield altitude and temperature; and (3) DOD policies, including regulations for use of strategic airlift and initiatives to improve the supply distribution process. This appendix describes some of these factors.

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## Operational Constraints

There are several operational factors that can affect the capacity utilized, including (1) aircraft availability, (2) aircraft characteristics, (3) cargo characteristics and loading configuration, and (4) route and fuel needs, among other factors. According to AMC officials, these factors, among others, contribute to capacity limitations.

## Aircraft Availability

Because airlift aircraft are normally in high demand and usually highly tasked, they are reserved for movement of forces and cargo critical to the successful execution of campaign plans. However, competing demands can limit the availability of aircraft to meet specific mission needs, forcing AMC planners to potentially use larger aircraft, such as the C-5, to transport payloads that cannot maximize the available space. Operational tempo and the number of aircraft undergoing maintenance and assigned for training needs and crew certification drive the total number of aircraft available to AMC officials at any given time. User requirements and threat situations may allow little or no flexibility in the delivery times, locations, and load configurations. Although exact numbers fluctuate daily, AMC generally has about 85 C-5 and C-17 aircraft available daily for strategic airlift missions. However, special events and maintenance problems can reduce the number and type of aircraft available for these missions. Officials told us that at the beginning of OEF, 17 C-5 aircraft were broken and grounded at Guam for maintenance. Efforts to improve the readiness rate of C-5 aircraft from 65 percent reduce the availability of these aircraft further and increase the need for C-17s. According to an AMC official, three C-17s are needed to replace each C-5. Because C-17 aircraft are also being used for intratheater airlift in Iraq, United States Central Command officials expressed concern about having enough C-17s to meet strategic airlift demands.

## Aircraft Characteristics

Aircraft characteristics, such as the size and shape of the aircraft's cargo compartment and strength of the aircraft floors and ramps, operational tempo, and chronological age, can impact an aircraft's capacity and the payload that can be transported. Aircraft have weight, height, and width

restrictions that can limit the amount or type of cargo that can be transported. For example, the maximum weight limit on a C-5 ramp is 7.5 short tons, and some locations within the aircraft require a 14-inch safety aisle to allow aircrew members clearance while securing cargo. Our review of mission planning files showed that sometimes cargo was not placed on the aircraft ramps because of weight constraints, thereby leaving some available space unused. Moreover, aircraft differ on what they can carry. For instance, the C-5 and C-17 can carry all cargo types as well as troops, while the C-141 can carry troops, cargo loaded on a standard-sized pallet (bulk), and oversized cargo—nonpalletized cargo that is larger than bulk, such as vehicles. In addition, an aircraft's contours can limit the height of pallets and rolling cargo placed in certain areas. For example, the KC-10 has a rounded cargo compartment that requires pallets be built to accommodate this shape; as a result, the pallets may have less cargo on them than they could theoretically transport.

The high operational tempo, number of flying hours, and the chronological age of aircraft can limit the payload that an aircraft can carry because these factors contribute to structural fatigue, corrosion, cracking, wear and tear on systems, and aircraft obsolescence. For example, United States Central Command officials told us that C-17 aircraft are being used extensively for both intratheater and strategic airlift for OIF, causing the aircraft to wear out and reach their retirement dates sooner than expected. As a result, these aircraft cannot carry payloads as heavy as would be expected.

#### Cargo Characteristics and Loading Configuration

Cargo dimensions, characteristics, and placement in an aircraft can impact capacity utilized. AMC categorizes cargo as (1) bulk—liquid or dry cargo that can be loaded on a standard-sized pallet without exceeding the pallet's dimensions; (2) oversized— nonpalletized rolling stock that is larger than bulk that exceeds the dimensions of a standard-sized pallet, but can be transported on a C-5, C-17, C-141, C-130, or KC-10; and (3) outsized—cargo that exceeds dimensions of oversized cargo and requires the use of a C-5 or C-17 aircraft. When scheduling airlift, AMC attempts to match cargo dimensions with the appropriate type of aircraft; however, a specific type of aircraft may not be available. Cargo characteristics can also affect aircraft capacity utilized. For example, ammunition is dense cargo that can be loaded with little wasted space, but helicopters are large, light, and irregularly shaped, and thus use cargo space less efficiently, as shown in figure 8.

**Figure 8: Unloading of a HH-60G Pave Hawk Helicopter from a C-17 in Support of OIF**



Source: DOD.

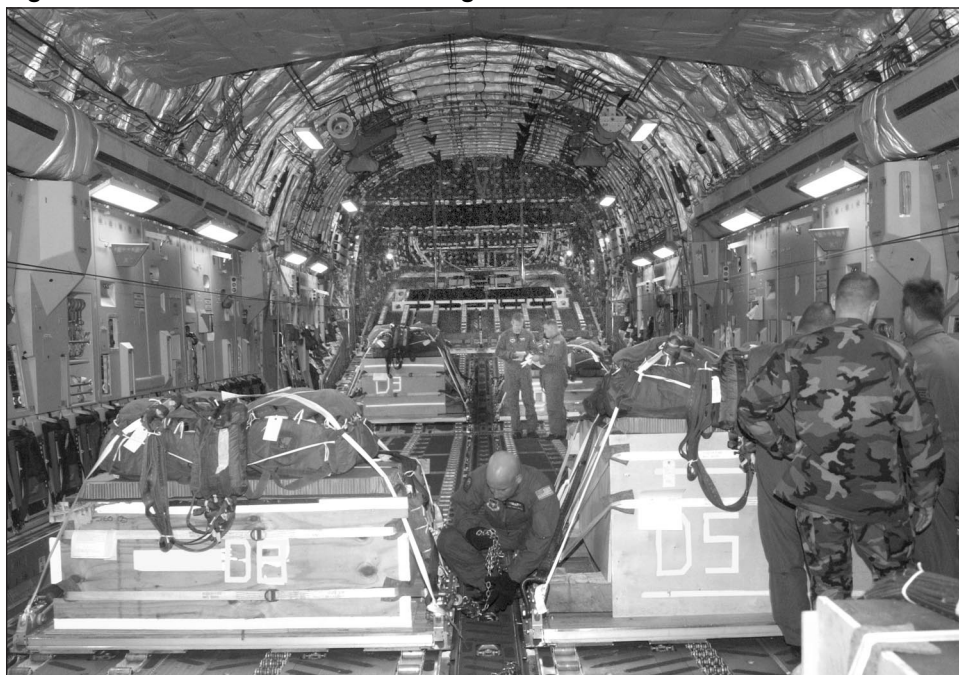
Note: A single Pave Hawk helicopter takes up most of a C-17's cargo compartment and uses multiple pallet positions. Thus, the helicopter's dimensions do not permit loading the C-17 to its maximum allowable cabin load.

Further, if hazardous material is transported, other types of cargo and passengers may not be loaded on the aircraft. If enough hazardous material is not available at the aerial port, payloads may be lighter. Each aircraft also has a specific number of positions—referred to as pallet positions—where cargo or passengers can be placed. For example, the C-5 aircraft has 36 pallet positions, and the C-17 has 18. Aerial ports—airfields that have been designated for the sustained air movement of personnel and cargo as well as authorized ports for entrance into or departure from the country where located—track the placement of cargo and passengers on the aircraft and the number of pallet positions used for each mission. The dimensions and type of cargo can require the use of more than one position, decreasing the amount of cargo or number of passengers that can be transported. Although all pallet positions on an aircraft may be used, the pallets may still have space for additional cargo to be placed on them. As a result, all pallet positions may appear to be used, but the pallets may not have met weight or volume limits. Cargo dimensions may also require the

use of multiple partial pallet positions. In addition, all airlifted cargo must be secured in place using rollers and tie-downs, as shown in figure 9.

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**Figure 9: Loadmasters Chain Down Cargo on a C-17**

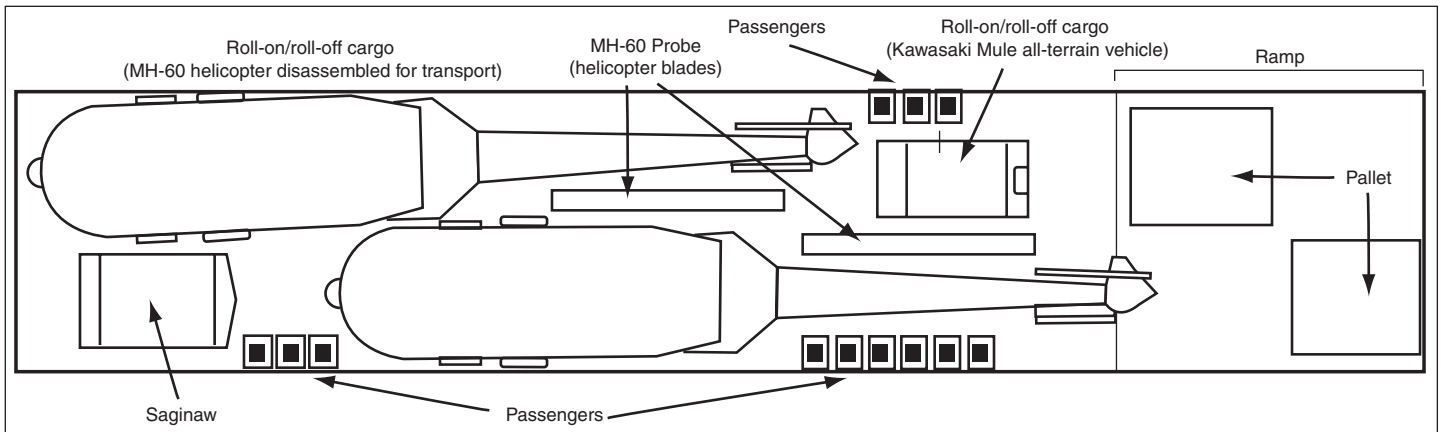


Source: DOD.

Some cargo must be transported in containers or with two or more pallets linked together. To secure these items, additional space on the aircraft may be needed, thus limiting the placement of additional cargo on board. Also, large equipment, such as helicopters, can take up a lot of space and result in lighter payloads. For example, in figure 10 (an actual load plan used during OEF), the total payload for cargo and passengers was approximately 30 short tons. Of this, the two helicopters took up about half of the C-17's cargo hold and accounted for about 19 short tons of the C-17's payload. Also, one helicopter's tail hangs over the ramp, preventing the use of this area. According to this load plan, it appears that the space available on the aircraft was efficiently used assuming that there was no additional cargo available to be loaded that would meet the ramp's weight limitations.

### Appendix III Operational Factors That Can Affect Aircraft Capacity Utilized

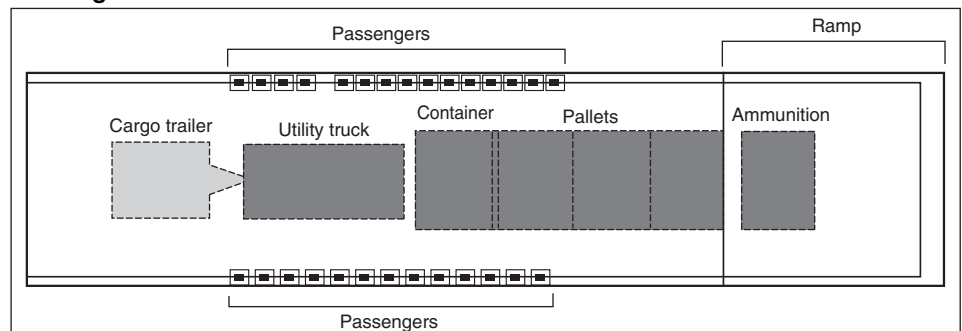
**Figure 10: Actual C-17 Load Plan Depicting How Placement of Cargo Can Decrease Payloads**



Source: AMC.

Figure 11 (an actual load plan used during OEF) shows how the presence of passengers can impact aircraft capacity utilized. When passengers are present, cargo must be placed down the center of the aircraft to provide an aisle for passengers. For this load plan, the total payload was approximately 23 short tons.

**Figure 11: Actual C-17 Load Plan Depicting Placement of Cargo to Accommodate Passengers**



Source: AMC.

### Fuel Considerations

Aircraft range and payloads are greatly affected by a mission's fuel requirements. As the distance increases, the fuel requirements increase and

the allowable payload decreases. For instance, if an aircraft must divert around a country because it does not have permission to fly over that nation's airspace or it must fly at higher altitudes due to security concerns, the aircraft may need to carry more fuel and less cargo and passengers. We have reported that an aircraft's range is significantly reduced with only minimal additional weight or due to security concerns. For example, for Stryker brigades every additional 1,000 tons of weight to be airlifted reduces aircraft range by 250 nautical miles and adds 15 aircraft loads.<sup>1</sup> We have also reported that a C-130 aircraft's range may be reduced if operational conditions such as high-speed takeoffs and threat-based route deviations exist because more fuel would be consumed under these conditions. Even under ideal flight conditions, such as daytime, low headwind, moderate air temperature, and low elevation, adding just a ton onboard the aircraft for associated cargo such as mission equipment, personnel, or ammunition reduces the C-130 aircraft's takeoff-to-landing range to 500 miles. Sometimes, the amount of cargo and distances involved in strategic airlift operations make air refueling necessary. AMC officials told us that air refueling is routinely done for aircraft flying to Iraq; Afghanistan; and Ramstein Air Base, Germany. Air refueling may reduce the aircraft's initial fuel requirement, allow for heavier cargo loads, increase aircraft range, and reduce the need for ground refueling. If refueling is not possible at the off-load station, such as in Khandahar, Afghanistan, potential payloads could be reduced or additional enroute stops could be required.

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## Environmental Factors

Environmental factors, such as altitude, pressure, weather, and temperature, can also affect the capacity utilized on an aircraft by forcing planners and operators to adjust mission payloads and timing to ensure effective, efficient, and safe mission accomplishment. High altitudes could prevent the use of certain types of aircraft or require lighter payloads and less fuel so that the aircraft can take off. For example, the Sierra Army Depot in Amadee, California, is located at a high altitude, and it is difficult for C-5s to get the lift they need to take off if carrying more than 30 short tons; this payload is about 42 short tons less than the payload planning

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<sup>1</sup>GAO, *Military Transformation: Realistic Deployment Timelines Needed for Army Stryker Brigades*, [GAO-03-801](#) (Washington, D.C.: June 30, 2003), and *Military Transformation: Fielding of Army's Stryker Vehicles Is Well Under Way, but Expectations for Their Transportability by C-130 Aircraft Need to Be Clarified*, [GAO-04-925](#) (Washington, D.C.: Aug. 12, 2004).



factor. As a result, AMC officials try not to use C-5 aircraft at this and similar locations unless C-17 aircraft are not available. AMC also needs to consider temperature changes during the winter and summer months. For instance, the allowable cabin load for aircraft flying into Rota Naval Base, Spain during the summer decreases by about 10 to 18 short tons because the temperature is too high for aircraft to maintain enough lift.

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## DOD Policies

Some DOD transportation-related policies, such as the pure pallet initiative and the primacy of commanders' decisions, may result in lighter payloads. DOD officials told us that the lighter payloads are acceptable in some instances because initiatives reduce risk and customer wait time in theater and AMC must meet commanders' time frames for delivery of cargo and passengers.

### Pure Pallet Initiative

While DOD's pure pallet initiative delivers palletized cargo to customers in the theater more quickly, it can result in lighter pallets and payloads. Initiated in March 2004 at Dover Air Force Base, Delaware; Charleston Air Force Base, South Carolina; and Ramstein Air Base, Germany, DOD's pure pallet initiative is intended to simplify and speed up airlift shipments into the United States Central Command's area of responsibility by building and shipping individual aircraft pallets with cargo for a single customer. The pure pallet initiative decreases the time needed on the receiving end to distribute palletized cargo to individual customers by transferring the sorting of cargo to the originating aerial port. Normally, a customer's cargo is loaded onto an aircraft pallet with cargo for other customers within the same region. Under this system, a single pallet could contain cargo for dozens of customers. The pallet would be broken down when it arrived at the destination aerial port, sorted, repalletized, and distributed to individual customers. When a pure pallet arrives at the deployed aerial port, it can be pulled from the aircraft and immediately handed off to the customer or placed on a truck or another aircraft for transport to remote locations. In addition, the initiative recognizes that in Iraq and Afghanistan, aerial ports are restricted as to the amount of cargo processing facilities, amount of equipment, and number of people because of the threat of attack. However, DOD officials acknowledge that having enough cargo to fill an entire pallet is problematic. To maximize pallet and aircraft utilization, the aerial ports can hold cargo for up to 5 days for the Army and up to 3 days for the Marine Corps. However, cargo is palletized when it reaches 120 hours of port hold time or enough cargo is available to fill a pallet causing it to either cube out or weigh out. As we reported in April



2005,<sup>2</sup> the result is potentially longer processing times at the originating aerial ports in order to reduce customer wait time in theater. AMC tracks pure pallet weights each week, aiming for an average of 1.4 short tons per pallet. AMC data show that all three aerial ports generally met or surpassed the average pure pallet weight goals.

Combatant Commander  
Decisions

According to AMC officials, the most efficient way to move passengers and cargo is not always the most appropriate during contingency operations. During OEF and OIF, combatant commanders frequently required AMC to transport troops with their equipment on the same aircraft. According to AMC officials, it would have been more efficient to move the troops on one aircraft and transport their equipment on a second aircraft immediately following the first. However, commanders fear that passengers would arrive at their destinations and equipment sent on the second aircraft would be delayed due to maintenance problems or, if sent on a military aircraft, the mission might be canceled. As a result, AMC may fly aircraft with reduced payloads in order to meet combatant commanders' delivery time frames. However, these decisions take into account the expected situation at the destination; some units, such as special operations forces and the Marines, immediately require their equipment, so separating passengers and equipment is not the preferred transportation method. Although the aircraft may be underutilized, AMC is meeting its primary objective to deliver "the right items to the right place at the right time."

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<sup>2</sup>GAO, *Defense Logistics: Actions Needed to Improve the Availability of Critical Items during Current and Future Operations*, [GAO-05-275](#) (Washington, D.C.: Apr. 8, 2005).

# Comments from the Department of Defense



DEPUTY UNDER SECRETARY OF DEFENSE FOR  
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SEP 12 2005

Mr. William M. Solis  
Director, Defense Capabilities  
and Management  
U.S. Government Accountability Office  
441 G. Street, N.W.  
Washington, DC 20548

Dear Mr. Solis:

This is the Department of Defense (DoD) response to the GAO draft report, "DEFENSE TRANSPORTATION: Air Mobility Command Needs to Collect and Analyze Better Data to Assess Aircraft Utilization," dated August 11, 2005 (GAO Code 350587/GAO-05-819).

The DoD concurs with the draft report recommendations. We agree to the benefits of improving the Global Air Transportation and Execution System (GATES), but emphasize other systems also are used to collect data regarding aircraft utilization. We also feel that Time Phased Force Deployment Data process should be included in an audit of aircraft utilization.

The Department appreciates the opportunity to comment on the draft report. For further questions concerning this report, please contact Colonel Michael Friedlein, Deputy, Assistant Deputy Under Secretary of Defense, Transportation Policy, 703-601-4461 ext 109.

Sincerely,

  
Jack Bell

Enclosure:  
As stated



**GAO DRAFT REPORT – DATED AUGUST 11, 2005  
GAO CODE 350587/GAO-05-819**

**“DEFENSE TRANSPORTATION: Air Mobility Command Needs  
to Collect and Analyze Better Data to Assess Aircraft Utilization”**

**DEPARTMENT OF DEFENSE COMMENTS  
TO THE RECOMMENDATIONS**

**RECOMMENDATION 1:** The GAO recommended that the Secretary of Defense direct the Secretary of the Air Force to direct the Commander, Air Mobility Command, to revise and clarify relevant Global Air Transportation and Execution System (GATES) data fields to capture a more comprehensive, well-defined list of operational factors that impact payloads for individual missions, and require supervisors to review those data fields for accuracy. Those factors include – but are not limited to – number of pallet positions used, cargo dimensions, whether pallets were heavy or light, fueling decisions, and altitude constraints. (Pages 18-19/GAO Draft Report)

**DOD RESPONSE:** Concur. It should be noted that all contingency missions are not processed through GATES. They are also processed through Service deployment systems. Additionally, GAO Report Data shortfalls for contingency missions can't be isolated to GATES. Altitude constraints, fueling decisions and other operational decisions conducted outside the aerial ports do not belong in GATES. GATES serves as an aerial port cargo and passenger management manifesting system, not as a full-spectrum airfield and airlift planning and execution system.

**RECOMMENDATION 2:** The GAO recommended that the Secretary of Defense direct the Secretary of the Air Force to direct the Commander, Air Mobility Command, to systematically collect and analyze information on operational factors that impact payloads transported on strategic airlift missions to identify ways that DoD may be able to use an aircraft's capacity as efficiently as possible. (Page 19/GAO Draft Report)

**DOD RESPONSE:** Concur. The Tanker/Airlift Control Center (TACC) already monitors and collects data on every contingency mission under Air Mobility Command's operational control. After aircraft departure, personnel in the TACC Fusion Cell are analyzing and gathering cargo and passenger data from several systems including the Global Transportation Network (GTN), GATES, and the Global Decision Support System (GDSS) to compile mission accomplishment data that includes Allowable Cabin Limits utilization by aircraft type. This further highlights that GATES is not the only system for information on aircraft utilization. Additionally, any audit of contingency aircraft utilization must include Time Phased Force Deployment Data validation process.

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# GAO Contact and Staff Acknowledgments

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## GAO Contact

William M. Solis (202) 512-5140

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## Acknowledgments

In addition to the contact name above, Ann Borseth, Assistant Director; Krislin M. Bolling; Virginia A. Chanley; Karen N. Harms; Linda S. Keefer; Ronald La Due Lake; Renee McElveen; Maria-Alaina I. Rambus; Vanessa R. Taylor; and Robert K. Wild also made key contributions to this report.

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